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APPLICATION NUMBER: *60/462,417*
FILING DATE: *April 11, 2003*
RELATED PCT APPLICATION NUMBER: *PCT/US04/11279*

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COMMISSIONER OF PATENTS AND TRADEMARKS

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PTO/SB/16 (10-01)
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. ET460724064US

JC879 U.S. PTO
60/462417

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Michael Joseph	Haun	Santa Rosa, CA

☐ *Additional inventors are being named on the _______ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

Products Made From Laminated-Glass Waste

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ Customer Number ______ *Type Customer Number here* → *Place Customer Number Bar Code Label here*

OR

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 10
☐ Drawing(s) *Number of Sheets* ______
☐ Application Data Sheet. See 37 CFR 1.76
☐ CD(s), Number ______
☑ Other (specify) Fee Transmittal Form

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☑ Applicant claims small entity status. See 37 CFR 1.27.
☐ A check or money order is enclosed to cover the filing fees
☐ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: ______
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.
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☐ Yes, the name of the U.S. Government agency and the Government contract number are: ______

Respectfully submitted,

SIGNATURE MJHaun

Date 04/11/2003

TYPED or PRINTED NAME Michael Joseph Haun

REGISTRATION NO. ______ *(if appropriate)*

TELEPHONE 707-538-0584

Docket Number: Haun LG1-P

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

60462417 .041103

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FEE TRANSMITTAL for FY 2003

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☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 80

Complete If Known	
Application Number	
Filing Date	
First Named Inventor	
Examiner Name	
Art Unit	
Attorney Docket No.	Haun LGI-P

METHOD OF PAYMENT (check all that apply)

☐ Check ☑ Credit card ☐ Money Order ☐ Other ☐ None

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	750	2001	375	Utility filing fee	
1002	330	2002	165	Design filing fee	
1003	520	2003	260	Plant filing fee	
1004	750	2004	375	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	80

SUBTOTAL (1) ($) 80

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X		=	
Independent Claims		- 3** =		X		=	
Multiple Dependent						=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	84	2201	42	Independent claims in excess of 3
1203	280	2203	140	Multiple dependent claim, if not paid
1204	84	2204	42	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

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FEE CALCULATION (continued)

3. ADDITIONAL FEES

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1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	410	2252	205	Extension for reply within second month	
1253	930	2253	465	Extension for reply within third month	
1254	1,450	2254	725	Extension for reply within fourth month	
1255	1,970	2255	985	Extension for reply within fifth month	
1401	320	2401	160	Notice of Appeal	
1402	320	2402	160	Filing a brief in support of an appeal	
1403	280	2403	140	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,300	2453	650	Petition to revive - unintentional	
1501	1,300	2501	650	Utility issue fee (or reissue)	
1502	470	2502	235	Design issue fee	
1503	630	2503	315	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	750	2809	375	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	750	2810	375	For each additional invention to be examined (37 CFR 1.129(b))	
1801	750	2801	375	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($)

SUBMITTED BY				(Complete *(if applicable)*)	
Name *(Print/Type)*	Michael Joseph Haun	Registration No. *(Attorney/Agent)*		Telephone	707-538-0584
Signature	MJ Haun			Date	04/11/2003

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60462417 .041103

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April 11, 2003

Box Provisional Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir or Madam:

Please find enclosed a Provisional Application for Patent, including:

- Provisional Application for Patent Cover Sheet with attached:
    - Fee Transmittal Form
    - Credit Card Payment Form
- Description of Invention (10 pages)
- Self-addressed postage-paid postcard for acknowledgment of receipt
- Certificate of Express Mailing (see below)

Please contact me if you need any additional information.

Respectfully Submitted,

MJ Haun

Michael J. Haun
Date: April 11, 2003

CERTIFICATE OF EXPRESS MAILING PURSUANT TO 37 C.F.R.

I herby certify that this New Provisional Application for Patent and the documents referred to as enclosed herein are being deposited with the United States Postal Service on this date 04/11/2003 in an envelop bearing "Express Mail Post Office to Addressee" Mailing Number ET460724064US addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Michael Joseph Haun
Typed or Printed Name of Person Mailing

MJ Haun
Signature of Person Mailing Papers

April 11, 2003
Date

TITLE

PRODUCTS MADE FROM LAMINATED-GLASS WASTE

DESCRIPTION OF INVENTION

The invention is directed to products made from laminated-glass waste, and a method for making products from laminated-glass waste. Examples of products that can be made by the invention are glass tiles and window panels, but other products can also be made. Laminated-glass waste in the invention refers to any industrial or post-consumer laminated glass that is discarded. Laminated glass is manufactured for transportation and architectural applications by bonding two pieces of annealed or tempered flat glass together with a plastic interlayer, usually consisting of polyvinyl butyral (PVB). For applications requiring curved surfaces, such as windshields, the flat glass is heated and shaped prior to the lamination process.

Large volumes of laminated-glass waste result from damaged automobile windshields and safety-glass windows. There are also other major sources of laminated-glass waste, including rejected glass at manufacturing plants, and end-of-life vehicles. Laminated-glass waste is currently recycled by crushing the glass and separating the PVB interlayer. Ideally, the glass and PVB should be recycled back into the primary applications of flat glass and PVB interlayer. However, because of technical and economic reasons, recycling of flat glass and PVB are limited to mainly secondary applications, as discussed below.

Flat glass waste can be crushed (referred to as cullet) and remelted into new glass products as part of the raw material batch. Flat glass production is usually limited to using only internal sources cullet, because of very demanding property requirements, such as transparency. External sources of cullet have larger variations in glass composition and contaminants, and thus

generally cannot be used in flat glass production. For this reason, recycled flat glass is mainly used in secondary applications, such as cullet for processing glass containers and fiber-glass insulation. Even though flat glass can be recycled, large volumes of flat glass are still disposed of in landfills.

The PVB interlayer from laminated-glass waste can be separated from the glass by crushing, but glass fragments tend to remain bonded to the PVB. Glass contamination limits the value of the PVB, and much of the PVB interlayer that is separated still ends up being disposed of in landfills. The glass contamination can be reduced by repeated crushing steps, however the cost of processing and energy required increases. Recycled PVB is used in secondary applications, such as flooring products.

Recycled glass can be sold as cullet to glass manufacturers for relatively low prices, similar to the cost of the raw materials that are replaced by the cullet. Recycled PVB is potentially worth many times that of recycled glass on a weight basis. However, only about five percent of the laminated glass is PVB, and thus the combined values of the recycled glass and PVB only amount to a few cents per pound of laminated-glass waste. The costs of collection, processing, and transportation of the waste materials with current methods greatly limit the economic viability of recycling laminated-waste glass. New processing methods and products are needed to improve the economics of laminated-waste glass recycling.

The present invention provides a low-cost energy-saving method of manufacturing glass products directly from laminated-glass waste without having to crush the glass and separate the PVB, even when the glass is cracked. The method involves firing the laminated-glass waste to fuse the glass layers and broken pieces into a single glass article. The PVB layer initially acts as a binder to hold the glass pieces together, but is then burned out during the firing prior to fusing

the glass pieces together. The PVB also contributes fuel to the firing, which reduces the energy needed for firing.

Firing laminated-glass waste with cracked glass produces unique textures and patterns in the fired glass articles. Each article has a different texture or pattern, because of the random fracture behavior of the glass. Multiple layers of laminated-glass waste can be stacked and then fired to increase the thickness of the glass article. Coatings can be applied to one or more surfaces of the glass layers to vary the appearance of the glass articles. The coatings allow different colors and patterns to be produced.

The main steps of the process comprise cutting laminated-glass, cracking the glass, applying coatings, and then stacking and firing at least two layers of laminated glass into a fused-glass product. Additional processing steps can also be included to vary the appearance of the final glass product without changing the scope of the invention. The main steps of the process, along with examples of additional steps, are discussed in more detail in the following paragraphs.

The first main step of the process comprises cutting the laminated-glass waste into pieces of laminated glass. The laminated-glass waste comprises two layers of glass bonded together by a plastic interlayer. The laminated-glass is cut perpendicular to the interlayer. Any method of cutting the laminated-glass waste can be used, but preferably the method results in smooth cut surfaces and edges, and maximizes the amount of glass remaining bonded to the plastic interlayer. One method for cutting the laminated glass is to use a saw for cutting ceramic or glass tile with a diamond-coated cutting wheel.

The pieces of laminated glass can be cut to the dimensions of the final glass product, or initially cut to larger dimensions and then cut to the final product dimensions after firing. The as-received laminated-glass waste can also be processed without initial cutting, and then

optionally cut after firing. The pieces of laminated glass can be cut in square or rectangular shapes, but other shapes can also be cut depending on the final product desired.

The second main step of the process comprises cracking the pieces of laminated glass. Sources of laminated-glass waste are usually already at least partially cracked. The purpose of the second step of cracking the glass is to produce the desired cracked pattern in the final product. If the as-received laminated-glass waste already has the desired cracked pattern, then the step of cracking the glass is not required. The first and second step can also be switched, where the as-received laminated glass waste is cracked first and then cut into the pieces of cracked-laminated glass.

Any method of cracking the pieces of laminated glass can be used. Preferably, the cracking method minimizes crushing of the glass, and maximizes the amount of glass that remains bonded to the plastic interlayer. Examples of cracking methods include manually or mechanically impacting the surface of the glass to produce cracks, and passing the laminated glass through a series of rollers to bend and crack the glass. The cracked pattern can be varied from producing many small pieces of glass to producing only a few large pieces of glass.

The third main step of the method comprises optionally coating the pieces of cracked-laminated glass. The purpose of the coating is the control the appearance or other properties of the glass product. The coating can be used to produce different colors, textures, and patterns, and to improve surface properties. The coating can be applied to any surface of the pieces of cracked-laminated glass, but preferably only the top surface is coated. The coating comprises inorganic materials that can withstand the firing temperatures needed to fuse the glass pieces together. The initial coating material can also contain organic material, but this material will burn out during the firing. Examples of the types of coatings that can be used include glazes,

enamels, metal foil, thick film pastes, thin film layers, and various powder mixtures.

The fourth main step of the process comprises stacking two or more of the cracked-laminated-glass pieces with optional coatings. Preferably, all of the pieces have about the same dimensions, and the first piece is placed on a flat surface with the plastic interlayer parallel to the flat surface, with each subsequent piece placed on top of, and aligned with, the preceding piece. Each piece of glass optionally has a coating applied. Any combination of pieces with and without coatings can be combined together into a stack.

Stacking and firing two or more pieces together provides a unique feature compared to if only one piece was fired. This is because the cracks in a single piece extend through the piece, but when two are more pieces are stacked together, the cracks only extend through the entire stack where the cracks in each piece overlap. Because each piece has a different random pattern of cracks, the overlap of cracks is minimized. This allows the pieces to fuse together with less flow of the glass during firing, which reduces the firing temperatures needed compared to firing a single piece of cracked laminated glass.

The fifth main step of the process comprises firing the stack of cracked-laminated-glass pieces with optional coatings into a fused glass product. Preferably a continuous kiln or furnace is used for firing, but a batch process can also be used. The plastic interlayer will burn out during firing. The heating rate and air supply during firing needs to be controlled so that the burn out is complete prior to fusing of the glass pieces. This will prevent carbon from becoming trapped in the fused glass. The firing profile of temperature and time required to fuse the glass pieces will depend on the composition of the glass in the laminated-glass waste, and on the desired appearance and properties of the glass product. The stack of cracked-laminated-glass pieces with optional coatings can be fired on a surface that minimizes the sticking of the glass to

the surface. Release agents, also referred to as kiln washes, can be coated on the surface to prevent sticking.

Additional processing steps can be conducted to further control the appearance and properties of the fused glass product if desired, but are not necessary. Examples of additional processing steps include cutting, applying coatings, refiring, and finishing the surfaces. The fused glass can be cut to smaller dimensions after firing, which will remove the rounded edges, and produce well defined edges on the final product. A coating or multiple coatings can also be applied to the surface of the glass after firing. A second firing can then be used to fire the coating or coatings. If the edges were cut after firing, then a second firing can be used to produce smoother and more rounded edges on the final product. Finishing the surfaces of the glass product can also be conducted by various methods including grinding, polishing, and etching.

The following paragraphs provide 11 examples of the invention. These examples demonstrate how the invention can be used to make glass products from laminated-glass waste. The glass products targeted by the examples are decorative glass tiles. The laminated-glass waste used in the examples was from a recycled automobile windshield with a thickness of about 0.2 inch. The windshield glass was light green colored. The plastic interlayer contained a blue color across part of the windshield, but this color burned out during firing. The windshield was cut into pieces with a diamond-coated cutting wheel on a saw designed for cutting ceramic tile. The pieces were washed with water, and dried in an oven at about 150°F. The pieces were fired in a kiln on a ceramic refractory kiln shelf coated with kiln wash. The plastic interlayer burned out during the firing, prior to fusing the glass pieces together. In each example, a firing temperature and a hold time are given, which correspond to the maximum temperature during

firing, and the hold time at the maximum temperature. The pieces were further processed as described in the following examples.

Example 1: A piece of the laminated-glass about 3 inches by 2 inches was cut from an automobile windshield. The piece was already cracked into many glass fragments, which were held together by the plastic interlayer, and thus was not further cracked. The piece was fired to 800°C with a hold time of ten minutes. The two layers of glass, originally on either side of the plastic interlayer, fused together. The edges of the glass fragments also fused together to form a single piece of glass. The lower surface of the glass, which was fired on the kiln wash, was flat, while the top surface had a textured pattern of grooves, corresponding to the initial cracks. The grooves in the top surface resulted because the glass did not flow enough to form a smooth surface, but did flow enough to cause the edges of the glass fragments to become rounded, and the adjacent fragments to fuse together. The glass was transparent after firing, and did not stick significantly to the kiln wash. This example demonstrates how a textured top surface can be produced with a flat lower surface. However, because only a single piece of laminated glass was used, some of the grooves extended all the way through the sample, which would be undesirable for many applications.

Example 2: Two pieces of the laminated-glass, each about 4 inches by 4 inches, were cut from an automobile windshield. Both pieces were already cracked into glass fragments, which were held together by the plastic interlayer, and thus were not further cracked. One piece was stacked on top of the other piece with the edges of the pieces aligned. Each piece of laminated glass had two layers of glass and one layer of plastic. The stack therefore had four layers of glass, and two layers of plastic. The stack was fired to 770°C with a hold time of thirty minutes. The four layers of glass, and the fragments of glass in each layer, fused together into a single

piece of glass. The lower surface of the glass was flat, while the top surface had a textured pattern of grooves, which corresponded to the cracked pattern of the laminated-glass piece that was placed on top of the stack. The grooves in the top surface did not extend through the glass piece as occurred in Example 1, because two pieces of laminated glass with different patterns of cracking were fused together. However, the grooves were deeper with less rounded edges compared to Example 1.

Example 3: The same procedure described above for Example 2 was used for this example, except that the maximum firing temperature was increased to 790°C, and the top piece of laminated glass in the stack was cracked prior to placing the piece on the stack. The top piece was cracked manually by impacting the surface with a pestle. The lower surface of the fused glass was again flat, and the top surface was grooved with a texture corresponding to the cracked pattern of the top piece of laminated glass. The grooves in the top surface were more rounded, and shallower than those of the fused-glass sample of Example 2.

Example 4: The same procedure described above for Example 2 was used for this example, except that the maximum firing temperature was increased to 810°C. The lower surface of the fused glass was again flat, but the textured pattern on the top surface was much smoother than the samples of Examples 1-3.

Example 5: The same procedure described above for Example 4 was used for this example, except that a coating was applied to the upper surface of the upper laminated glass-piece. The coating comprised a dry powder mixture of 95 weight percent clear container glass (milled to < 100 mesh) and 5 weight percent of a blue-colored ceramic stain. A layer of the mixture was spread on the surface. The firing caused the coating to fuse into a blue-colored glassy layer on the top surface of the fused-glass article. The top surface also had a textured

pattern, which corresponded to the cracked pattern of the laminated-glass piece that was placed of top of the stack.

Example 6: The same procedure described above for Example 4 was used for this example, except that a coating was spread on the upper surface of the lower laminated glass-piece, prior to stacking the pieces. This resulted in a coating between the pieces of laminated glass. The coating was similar to the coating used in Example 5. The firing caused the coating to fuse into a blue-colored glassy layer in the middle of the fused-glass article. The top surface also had a textured pattern, which corresponded to the cracked pattern of the laminated-glass piece that was placed of top of the stack.

Example 7: The same procedure described above for Example 6 was used for this example, except that the maximum firing temperature was changed to 790°C. The firing caused the coating to fuse into a blue-colored glassy layer in the middle of the fused-glass article. The top surface also had a textured pattern similar to that of Example 3.

Example 8: The same procedure described above for Example 3 was used for this example, except that an additional step was added. The additional step comprised cutting the edges of the fused-glass article with a diamond-coated wheel. This step removed the rounded edges, and produced well-defined edges on the article.

Example 9: The same procedure described above for Example 8 was used for this example, except that an additional step was added. The additional step comprised firing the article a second time to 790°C with a hold time of thirty minutes. The article was fired with the same orientation as used in the first firing. This step produced smoother and more rounded edges on the article. The top surface had grooves that were more rounded and shallower than those of the fused-glass sample of Example 3.

Example 10: The same procedure described above for Example 8 was used for this example, except that an additional step was added. The additional step comprised firing the article a second time to 790°C with a hold time of thirty minutes. The article was inverted (turned upside down) before firing the second time. This step produced smoother and more rounded edges on the article. The lower and top surfaces of the fused-glass article were flat without grooves, but within the article patterns were visible which corresponded to the cracked patterns of the laminated-glass pieces prior to the firings.

Example 11: The same procedure described above for Example 3 was used for this example, except that the two pieces of the laminated-glass were about 1 inch by 4 inches in size, and an additional step was included. The additional step comprised firing the stack of pieces on top of a stainless-steel mesh belt, instead of on the kiln wash. The top surface of the fused glass sample was similar to that of Example 3, but the lower surface had a grooved textured pattern, which corresponded to the pattern of the stainless-steel mesh belt. The fused-glass article was transparent, which allowed the pattern on the lower surface to be visible through the top surface.

A detailed description of the invention with examples was described above. It is understood that various other changes and modifications can be made to the present invention by those skilled in the art without departing from the scope of the invention. For example, additional coatings and finishing steps can be applied to the product if desired.